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This paper centers on the development of a research consortium to study ecological effects of dam removal. Long-time public interest has centered on the National Park Service's plan to remove two hydropower dams from the Elwha River in Olympic National Park. The Elwha is not only the largest dam removal ever attempted but is also unique in that land above the dams is within Olympic National Park, removing the confounding anthropogenic factors in other dam removals nationwide. I will provide a general update on the project to set the scene for the science part, which is actually the story I want to tell.

Interest in damming the Elwha River for electric power generation began in the late 19th century. A Canadian entrepreneur named Thomas Aldwell gained financing from George Glines and constructed the Elwha Dam five miles from the river mouth in 1913. The dam is 100 feet high and 400 feet long at its top. Although dams such as this were legally required to provide for passage of migrating fish, the Elwha Dam was constructed without any fish ladder or other provision for fish passage. A hatchery was built at the dam to compensate, but it was unsuccessful and closed in 1922. A second dam, Glines Canyon Dam, was constructed for additional power generation 13 miles upriver from the mouth between 1925 and 1927. The Glines Canyon Dam also lacks any provision for fish passage. Ownership of the dam and associated land remained in private hands until recently, but most of the land under Lake Mills was incorporated into Olympic National Park in 1940.

Anadromous fish such as salmon and steelhead have been restricted to the lower five miles of the Elwha River and tributaries for over 90 years. The Elwha was legendary for its enormous runs of salmon and steelhead. Spawning runs this size would have carried vast amounts of marine-derived nutrients to the upper reaches of the watershed where they were distributed into riparian and aquatic habitats, in effect fertilizing those upstream food webs. The dams and reservoirs also have radically affected the size and distribution of sediments in the lower Elwha and in the near shore marine environment. The middle and lower reaches of the river have been starved of small size sediments which have been trapped in the reservoirs. Today, 17 million cubic yards of sediment are believed to be trapped behind the dams.

Built as they were without fish passage, both dams would face expensive and difficult modification in order to be relicensed given current requirements. Because power is now widely available through the grid and several of the paper mills in the nearby town of Port Angeles are closed, the dams' power gradually became less important. Although controversial, in the 1980s public sentiment began shifting towards supporting the removal of the two dams. To resolve the controversies, Congress enacted the Elwha River Ecosystem and Fisheries Restoration Act of 1992 (PL102-495). This law provides for "the full restoration of the Elwha River ecosystem and native anadromous fisheries...." The Department of the Interior determined in 1995 that removal of both dams was required for full restoration.

The dams have now been bought by the federal government. Planning is well underway for their removal, which will begin in 2009, and for various mitigation and restoration measures. Current plans call for removing both dams at approximately the same time and allowing trapped sediments to wash down the river as quickly as possible. Removal will extend over perhaps two years, with activities suspended for periods when spawning fish return to the lower river, in order to allow sediments to clear.

A total of about $185 million has been authorized to pay for acquisition and removal of the dams, protection of the drinking water for Port Angeles, and some vegetation and fisheries restoration. But what is little known, even within the National Park Service, is that scientific research and monitoring were *not* funded by the Restoration Act. Numerous scientists in many disciplines (geology, hydrology, ecology, and fisheries) have been anxious to study this model system and have been frustrated by the lack of funding. A series of four workshops were held in which 150 scientists weighed in to propose and prioritize research. The Park Service has done its own analysis of needed research. But funding for it remains problematic.

Finding funding for Elwha restoration research has proven a difficult challenge. Because so much is being spent on the overall project, the task of asking funds of foundations and donors is a conundrum. Although everyone agrees that the Elwha is tantalizing; it's like the famous Pogo cartoon where Pogo says, "We're surrounded by insurmountable opportunity." It's hard to explain to someone that $185 million is being spent, but that you want them to donate!

After many attempts and frustrations in approaching foundations, in 2005, a group of local and regional players received National Science Foundation (NSF) support in the form of two grants totaling $1 million. The grants provided the basis for the Elwha Research Consortium. The Consortium is intended to create a level playing field for any scientist wishing to do research on the Elwha restoration, to synergize the research across institutions and disciplines, and to provide data infrastructure coordination. The core grant participants were Western Washington University, Olympic National Park, the Elwha Tribe, U.S. Geological Survey (USGS) Biological Resources Discipline (BRD), National Oceanographic and Atmospheric Administration (NOAA) Fisheries, Olympic Park Institute, and Peninsula College (a two-year college in Port Angeles). Many other partners have since joined the group. The process of assembling these partners and the story of how the grants were won is of some interest, because of the model used and its possible application to other situations.

Creation of the Elwha Research Consortium originated within the Natural Resources Division at Olympic National Park. The idea was to create a core group that included strong *local* support together with *bona fide* research capability. It was further the intention to bring together federal, tribal, and academic partners to enhance success for all. We used the urgency of the Elwha timeline to our advantage, stressing that needed information must be collected *now* before the dams are removed. Finally, realizing that although federal agencies are not eligible to receive NSF funding, we made a strong case for the federal/private partnership and how the funds could benefit both sectors.

Our first fortunate break was an award of $13,000 from the NPS North Coast and Cascades Research Learning Network to Jim Allaway, a scientist at Western Washington Univer-

sity. Allaway wrote a white paper outlining the history of the Elwha restoration project, underlining the need for research. This report proved to be critical, in part because it was well written, but also because it made a compelling case. The language in the Allaway report became the basis for the two NSF grants.

The first of the two successful grants was to NSF's Research Coordination Networks (RCN) for $500,000 over five years. This is an NSF program specifically intended to provide support for large, multi-institutional research projects. The grant does not actually fund any research, but it permits the scientists to meet, to travel, to coordinate work, to establish a web presence, and to work on data compatibility. This grant in effect established the Elwha Research Consortium. The principal investigator is Brad Smith, dean of the Huxley College of the Environment at Western Washington University.

The second grant was for Research Experience for Undergraduates (REU), also for $500,000 over several years. These grants are most commonly awarded to universities that use it for student summer support. In our case, the REU grant is providing stipends for 16 students each academic year. These students become the assistants for agency and academic researchers, providing an invaluable field presence throughout the year. These stipends are shared between Western Washington University and Peninsula College with a number each year targeted at Elwha tribal members. The two colleges have embarked on a major educational program incorporating the Elwha restoration project into their curriculum. Courses are taught in which biostatistics, field biology, social science, English composition, and the humanities are all integrated with a focus on the Elwha and the greater meaning of the river's restoration. The principal investigator is Bill Eaton, vice president of Peninsula College.

The Elwha Research Consortium is now in its second year. A board of directors has been formed and by-laws generated. Annual meetings have been held at which the various researchers currently doing Elwha work could meet and coordinate logistics for the field season. Separate sub-groups have organized under the consortium umbrella focused on "nearshore resources" (off the river's mouth) and "education/outreach." A committee is considering whether to create an "Elwha Research Foundation," which would be a 501(c)(3) non-profit to serve as a membership-based, fundraising partner of the consortium.

The non-intuitive, creative part of this story was in accepting that Olympic Park staff would make a significant contribution to writing the grants but receive no *direct* funding from them. Remember that although federal agencies cannot receive NSF funds, there is nothing to prevent NPS scientists from writing grants submitted through non-federal partners. We found that the trick was to find well-placed academics interested in the project and willing to become partners so long as they did not have to do the heavy lifting of writing the grants. Another important revelation was understanding the role played by "Office of Research" support staff. These folks play vital, behind-the-scenes roles and are expert at grant writing, budget planning, administration, and FastLane (NSF's project tracking software). They can be invaluable friends and unexpected partners.

Although most Elwha research is still being conducted on small grants to individual researchers, the "pie" is now much larger than before creation of the consortium. The non-federal partners in this case got the money but the agencies got the vital work started and continue to receive many value-added benefits such as field assistants, data management, and

increased public awareness. As word spreads of the growing consortium, more researchers are attracted to the project, writing their own grants, gradually filling in those scientific questions still needing answers.

The Elwha is a perfect test of whether removing dams can help restore a river. The lessons learned from restoring the Elwha will be in every ecology book for the next 50 years. The Elwha Research Consortium—based on teamwork, strategic partnerships, and scientific collaboration—will tell the tale.